PROCEEDINGS

OF THE

ROYAL SOCIETY OF EDINBURGH.

VOL. IV. 1860–61. No. 55.

Monday, 4th March 1861.

PROFESSOR CHRISTISON, Vice-President, in the Chair.

The following Communications were read :—

1. Memoir of the late Rev. Dr John Fleming. By Alexander Bryson, Esq.

2. On Zoological Classification, and the Parallelism of the Mammal, Marsupial, and Ornithic Classes. By Professor Macdonald.

The following Gentlemen were admitted as Fellows :—

ARCHIBALD GEIKIE, F.G.S.
WILLIAM HANDYSIDE, Esq.

The following Donations to the Library were announced :—

Quarterly Journal of the Chemical Society. January 1861.—*From the Society.*

The Canadian Journal. January 1861.—*From the Canadian Institute.*

Recherches expérimentales sur l'electricité des metaux. Par A. T. Kupffer. Tome I. St Petersbourg, 1860. 4to.—*From the Academy of St Petersburg.*

Annalen der königlichen Sternwarte bei München. Band XII.—*From the Royal Observatory of Munich.*

Transactions of the Pathological Society of London. Vol. XI. 8vo.—*From the Society.*

Ofversigt af K. Vetenskaps Academiens Forhandlingar. Stockholm, 1860. 8vo.—*From the Academy.*

Descriptive Catalogue of the Fossil Remains of Vertebrata in the Museum of the Asiatic Society of Bengal. By Hugh Falconer, M.D. Calcutta, 1859. 8vo.—*From the Author.*

Bulletin de la Société Vaudoise des Sciences Naturelles. Tome VI. No. 47. Lausanne, 1860. 8vo.—*From the Society.*

Sitzungsberichte der k. Bayer. Akademie der Wissenschaften. München, 1860. 8vo.—*From the Academy.*

Mémoires de la Société de Physique et d'Histoire Naturelle de Genève. Tome XV. Part 2. Geneva, 1860. 4to.—*From the Society.*

Kongliga Svenska Vetenskaps-Academiens Handlingar 1858. 4to. —*From the Royal Academy of Stockholm.*

Kongliga Svenska Fregatten Eugenies, &c. Stockholm, 1859. 4to.—*From the same.*

Meteorologiska Jakttagelser i Sverige af Er. Edlund. 1859. 4to. *From the same.*

Journal of Asiatic Society of Bengal. No. 3. 1860.—*From the Society.*

Madras Journal of Literature and Science. October 1859 to March 1860. 8vo.—*From the Madras Literary Society.*

Abhandlungen der Akademie der Wissenschaften zu Berlin. 1859. 4to.—*From the Academy.*

Annales de l'Observatoire Physique Central de Russie. St Petersbourg, 1860. 4to.—*From the Observatory.*

Monday, 18*th March* 1861.

The Hon. LORD NEAVES, Vice-President, in the Chair.

The following Communications were read :—

1. On the Properties of the Secretion of the Human Pancreas. By William Turner, M.B. (Lond.), Senior Demonstrator of Anatomy, University of Edinburgh.

The author obtained the pancreatic secretion at a post-mortem examination which he made of the body of a patient of Mr Spence's, who had died with a medullary tumour in the head of the pancreas, which, by compressing the biliary and pancreatic ducts, had produced dilatation of the ducts of the liver and gall-bladder, as well as dilatation of the ducts and lobules of the pancreas. The secretion was contained in the dilated parts of the gland last named, from which it was drawn off by means of a pipette. The fluid thus obtained was of an orange-yellow colour, and well-marked viscid consistency—sp. gr. 1·0105; appearance slightly turbid, owing to the presence of small white flakes, which a microscopic examination proved to consist of groups of small spherical, colourless cells, resembling, and most probably consisting of, the epithelial lining of the vesicles of the gland. Reaction faintly yet decidedly acid; heat, alcohol, corrosive sublimate, and bichloride of platinum threw down copious yellowish-white precipitates, consisting of the peculiar albuminous constituent of the secretion. No reduction was effected by boiling the fluid with freshly precipitated blue oxide of copper, showing the absence of sugar or any corresponding deoxidizing substance. The absence of sulpho-cyanide of potassium was shown by no reaction being given with a solution of perchloride of iron; thus affording a well-marked distinction between the composition of the human saliva and pancreatic juice. A partial emulsionizing effect was produced by rubbing some of the fluid with a little oil. With another portion of the secretion, starch was converted into dextrine. The action of the fluid upon albuminous substances was also tested, but a negative result was obtained. It should be stated, however, that but a small quantity of the secretion was now left, and that a day had elapsed between its withdrawal from the body and the appli-

cation of this test. The author then adverted to the accounts which have been given by various physiologists of the pancreatic fluid obtained from the different domestic animals which it is usual to experiment on when samples of this secretion are required, and concluded by showing in what respect the secretion of the human pancreas agreed with, or differed from, that of these animals.

2. On the Acrid Fluid of the Toad (*Bufo vulgaris*). By John Davy, M.D., F.R.S. Lond. and Edin., &c.

The author first adverts to the conflicting opinions respecting the nature of this fluid, and especially to one of the latest, that entertained by MM. Gratiolet and S. Cloez, that it is an active poison.

He next describes some experiments he has made for the purpose of testing their conclusion, the results of which are in opposition to theirs, and confirmatory of certain ones of his own, showing that the fluid is a simple acrid irritant, and as such well adapted to protect an animal otherwise defenceless, and, from its sluggish habits, peculiarly exposed to danger.

Incidentally, he makes some remarks on the toad of Barbadoes, which, brought from Dominica only a few years ago, has so multiplied as to abound in every part of the island. Its comparative rareness in Britain he attributes to two causes: one, the circumstance of the very young toad being, as he believes, destitute of the acrid fluid; another, the intolerance of the toad of all ages of severe cold, and in consequence, its liability to perish if the winter temperature be unusually low.

In a foot-note, he expresses the opinion, founded on one observation, that the female toad during the breeding season is without the protecting acrid fluid, the male at that time having it in more than ordinary abundance, and, from position, whilst the ova are *in transitu*, probably defending his mate.

3. On Gyrolite occurring with Calcite in Apophyllite in the Trap of the Bay of Fundy. By Henry How, Professor of Chemistry and Natural History, King's College, Windsor, Nova Scotia.

The mineral gyrolite was first described by Professor Anderson of Glasgow,* as a new species from the Isle of Skye; it is stated by

* Trans. Roy. Soc. Edin., and Phil. Mag. Feb. 1851.

Greg and Lettsom* to occur without doubt at two localities in Greenland, and according to Heddle at Faröe. The only other notice of it that I am acquainted with is by L. Sæmann, who mentions† that he examined a specimen—no locality being given—mixed or interlaminated with pectolite, and suggests that this mineral, losing its alkali, becomes gyrolite, and, losing its lime, becomes okenite. No other analysis than the original one of Professor Anderson has, I believe, been published; the following account of its occurrence among the minerals of Nova Scotia shows it in such associations as affords a mode of explaining its origin by change in apophyllite.

I met with it in Annapolis Co., N.S., some 25 miles S.W. of Cape Blomida, between Margaretville and Port George, on the surface of fractured crystalline apophyllite, and, on further breaking the mass, a good many spherical concretions of pearly lustrous plates were observed in the interior, of sizes varying from that of a pin's head to nearly half-an-inch in diameter; their outline was well defined, and the external characters, as given by Anderson, were recognised on examination; it afforded the following results on analysis:—The mineral was ignited for water, and the residue treated with hydrochloric acid, the resulting dried silica was weighed, and then fused with carbonated alkali, and the weight of the small quantities of alumina, &c., so separated, was deducted from that of the first silica. I place my numbers by the side of those of Professor Anderson, and give the calculated percentages for his formula:—

	H. H.	Anderson.	Calculation.	
Potass, . .	1·60			
Magnesia, .	0·08	0·18		
Alumina, .	1·27	1·48		
Lime, . .	29·95	33·24	32·26	2 CaO = 56
Silica, . .	51·90	50·70	52.18	2 SiO_3 = 90·6
Water, . .	15·05	14·18	15·35	3 HO = 27
	99·85	99·78	99·99	173·6

and a general accordance is observed sufficient to show the identity of chemical composition in the minerals examined; the small quantity of potass present in my specimen probably modified the blowpipe characters a little, as I found it not to exfoliate completely, and it fused without any difficulty, and even with some boiling.

* Manual of Mineralogy, p. 217.

† First Supp. to Dana's Mineralogy, p. 9. Silliman, May 1855.

Some of the numerous cavities in the apophyllite were empty, some entirely filled with gyrolite, and in others separate plates of this mineral were standing edgewise, leaving vacant spaces, while, upon and by the side of the plates were in some cases rhombohedral crystals, which proved to consist of calcite, and were sometimes present alone in the cavities, which varied from being quite shallow to half-an-inch in depth. It is mentioned by Anderson that gyrolite occurs associated with stilbite, laumonite, and other zeolites, and is sometimes found coating crystals of apophyllite.

The difference in chemical composition between apophyllite and gyrolite is very well seen on comparing the respective theoretical percentages of their constituents; thus,

	SiO_3.	CaO.	KO.	HO.
Apophyllite,	=52·70	26·00	4·40	16·70 + HF variable;
Gyrolite,	=52·18	32·26		15·50;

and the existence of the calcite in the cavities seems clearly to show, that the gyrolite is formed from the apophyllite by the action of the water which deposited the carbonate of lime, reacting on the silicate of potass, and dissolving out at the same time the fluorine or fluoride of calcium;* trial was made for fluorine on two fragments of the gyrolite, and no evidence of its existence obtained.

4. On Natro-boro-calcite, and another Borate occurring in the Gypsum of Nova Scotia. By Henry How, Professor of Chemistry and Natural History, King's College, Windsor, N.S.

About three years and a half ago, I showed the existence of Natro-boro-calcite in the gypsum of Windsor, N.S.† I was not aware at that time that Dr Hayes of Boston, U.S., had announced his conviction‡ that the soda which had been attributed to this mineral was an impurity, and had given, as the true expression of the composition of the pure mineral, the formula $CaO\ 2\,BO_3 + 6\ HO$. Had I known this, I should have adverted to the probability of his mineral (Hayesine, Dana) constituting a distinct species from Natro-boro-calcite, whose existence seems to be sufficiently established by the repeated finding of not very dissimilar quantities of soda in analyses

* Dana's Mineralogy, i. p. 332, 333.

† Edin. New Philosophical Journal, July 1857. Silliman, Sept. 1857.

‡ Silliman, Nov. 1854, p. 95.

of specimens from two of its three localities, as seen in the following list, which contains all the analyses I have been able to find :—

	BO_3.	CaO.	HO.	NaO.	KO.	SO_3.	NaCl.	Sand.	
Peru, .	46·11	18·89	35·00						Hayes*
Tuscany, .	51·135	20·85	26·25						Bechi*
Peru, .	49·50	15·90	25·80	8·8					Ulex†
Peru, .	49·50	17·70	26·00	8·8					„ †
„ .	45·46	14·32		8·22	0·51	1·10	2·65	0·32	Dick*
„ .	43·70	13·11	35·67	6·67	0·83				Ramm.‡
„ .	47·25	15·98	25·46	9·88		0·45		0·98	Anderson§
Nova Scotia,	41·97	13·95	34·39	8·36		1·29	MgO	0·04	H. How*
„	44·10	14·20	34·49	7·21					„

In the account of the analysis by Anderson, the quantities of soda and sulphuric acid, as given above, are reversed ; from the conclusion drawn by the author, this is evidently a typographical error. As regards the amount of water present, no mention is made, in any case but my own, as to the temperature at which the substance was dried ; in my analysis the mineral was air-dried. The soda, it will be observed, is a constant ingredient, in pretty uniform amount, in all but the first two analyses ; and in my, examination as stated at the time, the mineral was washed, for the second analysis, with cold water till all sulphuric acid was removed.

From the preceding data the following formulæ have been deduced :—

$CaO\ 2\ BO_3 + 6\ HO$	Hayes ;
$NaO\ 2\ BO_3 + 2\ CaO,\ 3\ BO_3 + 10\ HO.$	Ulex ;
$NaO\ 2\ BO_3 + 2\ CaO,\ 3\ BO_3 + 15\ HO.$	H. How ;
$NaO\ 2\ BO_3 + 2\ (CaO\ 2\ BO_3) + 18\ HO.$	Rammelsberg ;

all referring to a mineral found in rounded masses, consisting of interwoven fibres, opaque, snow-white, and of a silky lustre.

The mineral to which I would now draw attention was found in the same quarry as the preceding, at a distance of about 100 yards, and at about 20 feet lower level, and also associated with glauber-salt, which, it is worthy of notice, is generally met with here, according to the quarrymen, in narrow seams at the line of junction of the "hard plaster" (anhydrite) with the "soft plaster" (gypsum). I detected it in the form of an opaque white substance without lustre,

* Dana's Min., 4th ed., p. 394.

† Liebig und Kopp's Jahrb. 1849, p. 780.

‡ Silliman, Sept. 1856, 3d Supt. to Dana's Min., p. 6.

§ Proc. Phil. Soc. Glasgow, Feb. 1853.

and, to the naked eye, devoid of crystalline structure, in cakes and somewhat rounded masses, varying in size from that of a small pea to that of a bean; these masses lay between gypsum and crystals of glauber-salt, taking shape from the crystals of the latter on the side next to them, and, when detached from them, leaving their faces, as it were etched, and sometimes the crystals were penetrated to a considerable depth by the imbedded borate. The mineral is very soft, H = 1, but coherent, tasteless, slightly tough between the teeth, fuses readily before the blowpipe to a clear bead, insoluble in water, soluble in hydrochloric acid. As found, or very soon after being brought home, it lost by exposure to the air,—

Water = 18·36 per cent.,

and the air-dried substance gave the following results on analysis; the water was determined by ignition; the lime, magnesia, and sulphuric acid in one portion of the so dried residue, and the soda in another, after its treatment with fluor-spar and sulphuric acid for elimination of boracic acid, which was, of course, estimated by deficiency:—

	I.	II.
Lime, ...	14·21	
Soda, ...	7·25	
Sulphuric acid, . . .	3·98	
Magnesia, . . .	0·62	
Water, ...	19·96	20·78
Boracic acid, . . .	53·98	
	100·00	

The quantity of mineral obtained did not permit me to make more than one analysis and retain a little as a specimen for identification; but these results, as well as the characters already mentioned, and the crystalline structure to which I shall presently advert, are, I think, sufficient to show that it is specifically distinct from Natro-boro-calcite (see analyses, p. 429). On the assumption that the magnesia and sulphuric acid are accidental, and that the latter is combined with the former, and with a quantity of soda equivalent to that of the acid not required by the magnesia, I have calculated the preceding results (I.) after making these deductions, and at the same time taking away the amount of water necessary to render the $MgO\ SO_3 = MgO\ SO_3 + 7$ aq. (the hydrated sulphate of soda would

of course, become anhydrous on exposure to dry air); the results then become :—

	Oxygen.	Ratio.	Calculation.		
Lime, . .	15·55 = 4·44	3·08	3 CaO	84	15·46
Soda, . .	5·61 = 1·44	1	NaO	31	5·77
Water, . .	19·72 = 17·52	12·16	12 HO	108	20·11
Boracic acid, .	59·10 = 40·47	28·10	9 BO_3	314·1	58·48
	99·98			537·1	100·00

—corresponding to the formula,

$$NaO, 3\ CaO, 9\ BO_3 + 12\ HO.$$

I am very well aware that it is unsafe to base a formula upon a single analysis, especially of a mineral substance, and most especially after making deductions as above, and I cannot, in this case, insist on the one brought out, but it is not anomalous. We find rather complex combinations both in the natural and artificially formed compounds of boracic acid; thus,

Hydroboracite,* = 3 CaO, 4 BO_3 + 3 MgO, 4 BO_3 + 18 HO, and
Larderellite,* = NH_4O, 4 BO_3 + 4 HO ;

while Laurent describes† a salt = 5 NaO, 24 BO_3 + 52 HO, and Rose one‡ = 3 CaO, 5 BO_3 when ignited; and it is a little curious that the formula given above includes the soda compound corresponding to Larderellite and the salt of Rose—

$$NaO, 4\ BO_3 + 3\ CaO, 4\ BO_3 + 12\ aq.$$

I mentioned that the mineral presented no appearance of crystalline structure to the naked eye. Not having at hand, at the time I was at work upon it, a sufficiently good microscope, I sent a portion of the mineral to Professor Robb, of the University of New Brunswick, at Fredericton, with a letter stating my results and my doubt as to the substance being crystalline. I received this answer—" In spite of your odd formula, the mineral just as I got it, untouched and unwashed, is perfectly crystalline in every particle. A good power is required; but with a magnifying power of about 350 diameters there is no difficulty, the form comes out as sharp as possible. The crystals are excessively thin translucent tables or plates. They have a rhombic outline, and the angles probably = 80° or more,

* Dana's Min., 4th ed., 394, 395.
† Liebig und Kopp's Jahresbericht, 1849, p. 226.
‡ Ibid., 1842, p. 313.

Owing to their excessive thinness I could not say whether they could be called right or oblique rhombic prisms; I suspect the latter from analogy. By care the 'Tiza' (Natro-boro-calcite) can be shown to consist of very fine prisms, sharp, angular, and long, but too fine for me to state their form. The diameter was less than ·00118 of an English inch. The long prismatic needles of the Tiza are in great contrast to the broad tables of the recent mineral in your last letter; of that the plates are about ·0048 of an inch from side to side, but some are a little larger, others a little smaller. In some you see regular cleavage—that is, a small rhomb chipped out of one side. As far as form goes, therefore, it would seem to be a distinct and definite species. I presume it was formed in a dry place, for the angles were quite sharp. The connection between these borates and sulphates of lime and sulphate of soda is very curious."

I may state that I had subsequently the opportunity of appreciating the great accuracy of this description of the appearance of the two minerals.

Arguing from the chemical composition, which, however, may not be quite established, and the crystalline structure, I conceive the mineral in question to constitute a new species, and I propose for it the name of Cryptomorphite (κρυπτος occultus, and μορφη forma), in allusion to its microscopic crystalline structure.

The truth of the last sentence in Professor Robb's letter is very apparent. In my former paper on the subject, I adverted to the existence of Natro-boro-calcite in the gypsum here, as confirming Dawson's theory of the origin of the rock from the action of volcanic waters on carbonate of lime. It is interesting to observe that Bechi* found the same (?) mineral, with other borates, in the lagoons of Tuscany. The hydrated condition of both the borates found here, and of the associated sulphate of soda, shows the action of water; but that of ordinary sea-water would not account for the presence of boracic acid. As regards the soda, the sulphate and borate of lime were probably the substances originally present, and chloride of sodium in water being introduced might remove part of the calcium as chloride, and furnish borate and sulphate of soda. It is confirmatory of this view that a small quantity of rock-salt in crystalline grains has recently been found in the gypsum.

* Dana's Min., 4th ed., pp. 394, 395.

5. On some Derivatives from the Olefines. By Frederick Guthrie, Professor of Chemistry and Physics in the Royal College, Mauritius.

This paper is supplementary to, and forms the sequel of, a series of papers which have been published in the "Quarterly Journal of the Chemical Society of London."

In continuing the examination of the behaviour of the olefines towards compound halogens, certain compounds previously described have been submitted to a test of homogeneity, of which the following is the principle:—

"If a body be partly dissolved in a solvent, and if the dissolved part and the undissolved part, or the dissolved part and the whole, or the undissolved part and the whole, have the same composition, then the body is a simple one."

Examined in this manner with regard to the solvent alcohol, the bisulphochlorides of ethylen and amylen were shown to be true chemical compounds.

The bisulphochloride of ethylen was submitted to the action of chlorine, whereupon a body was formed identical with that got by the action of chlorine upon the bisulphochloride of chlorethylen or upon the bisulphide of ethyl—namely, the chlorosulphide of bichlorethylen or sulphide of terchlorethyl

$$C_4\ H_2\ Cl_3\ S.$$

Further, the same body $C_4\ H_4\ S_2\ Cl$ was submitted, in alcoholic solution, to the action of hydrate of potash, which converted it into

$$C_4\ H_4\ S_2\ OHO.$$

Again, the body $C_{10}\ H_{10}\ S_2\ Cl$ (whose equivalent of chlorine has been shown to be replacible by O and by OHO), on treatment with cyanide and sulphocyanide of potassium in alcoholic solution, exchanges its chlorine for cyanogen or sulphocyanogen respectively, giving rise to

Bithiocyanide of amylen, $C_{10}\ H_{10}\ S_2\ Cy$

and Bithiosulphocyanide of amylen, $C_{10}\ H_{10}\ S_2\ S_2\ Cy$

respectively.

From these and analogous reactions previously described, the conclusion is drawn that the bodies $C_4\ H_4\ S_2\ Cl$ and $C_{10}\ H_{10}\ S_8\ Cl$

behave towards chlorine like the sulphides of chloriniferous radicles,

$$C_4 \left.\begin{matrix} H_4 \\ Cl \end{matrix}\right\} S_2 \qquad C_{10} \left.\begin{matrix} H_{10} \\ Cl \end{matrix}\right\} S_2 ;$$

while towards metallic oxides, hydrated oxides, cyanides, and sulphocyanides, they behave like chlorides of sulphuriferous radicles,

$$C_4 \left.\begin{matrix} H_4 \\ S_2 \end{matrix}\right\} Cl \qquad C_{10} \left.\begin{matrix} H_{10} \\ S_2 \end{matrix}\right\} Cl.$$

The bisulphide of amylen,

$$C_{10} H_{10} S_2,$$

was produced by the withdrawal of the chlorine from $C_{10} H_{10} S_2 Cl$ by means of metallic zinc—a reaction analogous to the reduction of kakodyl from its chloride.

The bichloride of amylen,

$$C_{10} H_{10} Cl_2,$$

could not be formed by the direct union of chlorine and amylen, but was produced by the action of amylen upon the pentachloride of phosphorus.

The binitroxide of amylen,

$$C_{10} H_{10} 2NO_4,$$

which is formed in small quantity when nitric acid and amylen react on one another, was formed in abundance when NO_4 was led into amylen. This reaction shows how completely NO_4 obeys the laws of the halogens, and leads to its being called nitroxine. The same property is again illustrated by the conversion of the latter body into bicyanide of amylen,

$$C_{10} H_{10} Cy_2 + 5Aq,$$

by the action of cyanide of potassium in alcoholic solution, the nitrite of potash or nitroxide of potassium KNO_4 being formed at the same time. The five equivalents of water are feebly combined. An experiment to procure the pimelate of potash from the bicyanide of amylen by the action of caustic potash was without result.

By the action of nitric acid upon the bisulphochloride of amylen the nitroxisulphide of nitroxamylen is formed,

$$C_{10} \begin{matrix} H_9 \\ NO_4 \end{matrix} SNO_4,$$

together with a conjugate sulphur acid.

Finally, when zinc-ethyl and bisulphochloride of amylen are brought together in ethereal solution, the chlorine of the latter body is replaced by ethyl, and a body formed having the constitution and properties of the bisulphide of œnanthyl—

$C_{10} H_{10} S_2 C_4 H_5$ Bisulphethide of amylen,
or $C_{14} H_{15} S_2$ Bisulphide of œnanthyl.

A list is given of the compounds hitherto obtained by the action of certain compound halogens upon the olefines ethylen and amylen.

The use of the terms Recomposition, Isotype, Idiotype, are explained, and a method given for determining the specific gravity of small quantities of liquids, which are heavier than and insoluble in water.

The following Gentleman was admitted an Ordinary Fellow:—

George Berry, Esq.

The following Donations to the Library were announced :—

Proceedings of the Royal Horticultural Society, Vol. I., No. 21. —*From the Society.*

Monthly Notices of Astronomical Society, Vol. XXI., No. 4.—*From the Society.*

Journal of Royal Dublin Society, Nos. 18 and 19.—*From the Society.*

Journal of Agriculture, March 1861.—*From the Highland Society.*

On a new genus of Echinoderms, and Observations on the genus Palæchinus. By Fort-Major Thomas Austin, F.G.S.—*From the Author.*

Quarterly Return of Births, Deaths, and Marriages registered in Scotland, for quarter ending 31st December 1860.—*From the Registrar-General.*

Journal of Royal Geographical Society, Vol. XXX., 1860. 8vo.—*From the Society.*

A Lunar Tidal Wave in Lake Michigan demonstrated. By Brevet Lieut.-Colonel J. D. Graham.—*From the Author.*

Fortschritte der Physik im Jahre 1858. Berlin, 1860.—*From the Physical Society of Berlin.*

Les Libre Echangistes et les Protectionistes Conciliés. Par J. Du Mesnil-Marigny. Paris, 1860.—*From the Author.*

The Mathematical Works of Isaac Barrow. Edited by W. Whewell. Cambridge, 1860. 8vo.—*From the Editor.*

On the Structure of the North-Western Highlands. By James Nicol, F.G.S., F.R.S.E.—*From the Author.*

Schriften der Universität zu Kiel, 1859.—*From the University.*

Transactions of the Philosophical Institute of Victoria, Vol. IV., Part 2. Melbourne, 1860.—*From the Institute.*

Journal of Statistical Society of London, March 1861.—*From the Society.*

Monday, 1st April 1861.

DR CHRISTISON, V.P., in the Chair.

The following Communications were read:—

1. On the Molecular Theory of Organization. By Professor Bennett, M.D., F.R.S.E., &c.

Parodying the celebrated expression of Harvey, viz., *Omne animal ex ovo*, it has been attempted to formularise the law of development by the expression *omnis cellula e cellula*, and to maintain "that we must not transfer the seat of real action to any point beyond the cell."* In the attempts which have been made to support this exclusive doctrine, and to give all the tissues and all vital properties a cell origin, the great importance of the molecular element, it seemed to the author, had been strangely overlooked. It becomes important, therefore, to show that real action, both physical and vital, may be seated in minute particles, or molecules much smaller than cells, and that we must obtain a knowledge of such action in these molecules if we desire to comprehend the laws of organization. To this end the author directed attention: 1*st*, To a description of the nature and mode of origin of organic molecules; 2*d*, To a demonstration of the fact that these molecules possess inherent powers or forces, and are present in all those tissues which manifest vital force; and 3*d*, To a law which governs the combination, arrangement, and behaviour of these molecules during the development of organised tissue.

I. By a *molecule* was understood a minute body, seen under high magnifying powers in all organic fluids and textures, varying in size from the four-thousandth of an inch down to a scarcely visible point, which may be calculated at much less than the twenty-thousandth of an inch in diameter. Optically it is distinguished according to its size—the smallest presenting dark or light points as the focus is changed, and the larger exhibiting a dark or light centre,

* Virchow, Eng. Trans. p. 3.

surrounded by a distinctly shadowed ring. These last are frequently distinguished by the name of *granules*. The ultimate molecule had never been reached even with the highest magnifying powers. In the same manner that the astronomer with his telescope resolves nebulæ into clusters of stars, and sees other nebulæ beyond them, so the histologist with his microscope magnifies molecules into granules, and sees further molecules come into view. The chemical composition of these molecules must vary infinitely, but the author had been in the habit of classifying them into three groups and referring them to, 1*st*, the albuminous, 2*d*, the fatty, and 3*d*, the mineral compounds. These constituents may be mingled together in various proportions, so as to produce simple and compound molecules. In the vast majority of cases they are globular in shape, but they may be angular, square, and of various forms. They may differ in size or be of tolerably uniform size in the same liquid or substance. They may be regularly or irregularly diffused in the matter examined. Sometimes they are concentrated in particular places, and at others scattered in groups. Their colour is various. Most of the pigments in plants and animals are dependent on the formation of molecules, which in the human lung have been proved to be pure carbon, and in the tissues of plants and animals differently tinted kinds of fat or of wax.

These molecules may be formed in two different ways,—1*st*, by precipitation in fluids; 2*d*, by the disintegration of previously formed tissues. The former may be called *histogenetic* (ἱστος and γένεσις, *generatio*), and the latter *histolytic* (ἱστος and λυσις, *dissolutio*). They may be denominated molecules of formation and molecules of disintegration.

Histogenetic molecules are formed either from the union of two simple organic fluids or from precipitations occurring in formative fluids, holding various substances in solution. Fourteen years ago the author read to the Society a paper giving an account of the results obtained by a union of oil and liquid albumen, the two organic fluids from which molecular matter is most commonly derived. It was Dr Ascherson of Berlin, who first discovered the important fact, that the mere contact of oil and fluid albumen caused the latter to coagulate in the form of a membrane, which he called the haptogen membrane, from 'Απτομαὶ to come in contact. A more complete mixture of two such drops produces, as is well known, a white

opaque fluid or emulsion, which in structure exactly resembles milk. That is to say, it consists of molecules composed of a drop of oil surrounded by a layer or membrane of coagulated albumen. Such compound molecules possessing the property of endosmose may therefore readily be produced artificially, and by trituration can be reduced in size so as to resemble the elementary molecules in chyle or in the yolk of the egg. If oil and albumen be introduced into the stomach and intestinal canal, they are always so reduced; and one of the objects of digestion would appear to be separating from the food, and rendering fluid its oil and albumen, so as to produce the chyle molecules which are ultimately transformed into blood. Indeed, everywhere in living organisms it may be observed, that oil and albumen formed as secretions by plants, and entering the bodies of animals as food, either separately or united, constitute the chief origin of molecular formations.

Mr Rainey has recently pointed out the condition which causes molecular mineral matter to assume the form of rounded nuclear bodies.* This condition is viscosity. If carbonate of lime be dissolved in water, the forms produced on its precipitation are crystalline; but if the fluid be glutinous, composed, for example, of fluid, gelatine, or gum, the forms produced are oval or globular. Precipitations made in this way on slides of glass, closely resemble the appearances called nuclear or cellular in different stages of development. Mr Rainey has further shown how starch granules are produced in the juices of vegetables by the endosmose of gum into a cell containing a solution of dextrine.† In the same manner that the contact of oil and albumen produces oleo-albuminous molecules, so does the contact of gum and dextrine precipitate starch molecules. In this manner we can comprehend how the mixture of various organic fluids gives rise to particles of different kinds.

Histolytic molecules are the result of the transformation and disintegration of fluid and solid substances by chemical or mechanical action. They are generally larger in size than histogenetic molecules, are more purely fatty, and from being associated with the debris of broken-down texture may, in most instances, readily be distinguished. Thus, in the breaking up of cells and of muscles when they become fatty,

* On the Mode of Formation of Shells of Animals, of Bone, and of several other Structures, by a process of Molecular Coalescence, &c. By George Rainey, M.R.C.S. London, 1858.

† Microscopical Journal, 1859.

or in the putrefaction of vegetable or animal matters, these may be seen to soften, lose their peculiar structure, break up, and ultimately be reduced to a molecular condition.

We shall subsequently see that these two kinds of molecules are constantly changing places, or, in other words, molecular matter formed from the process of disintegration may, when placed under peculiar circumstances, become the basis of matter which undergoes development. In nature, the breaking down of one substance is the necessary step to the formation of another, and the histolytic or disintegrative molecules of one period become the histogenetic or formative molecules of another. This fact constitutes the basis of the law which I shall subsequently seek to establish.

II. The author pointed out, in the second place, that these molecules are governed by forces, which induce among them a variety of movements, and cause them to combine in definite ways. This force, which we may call *molecular force*, is altogether independent of cell, nucleus, or other form of structure.

1*st*, He alluded to the well-known molecular movements described by Robert Brown. These vibratile, circular, serpentine, or irregular motions may be observed whenever molecules are suspended in fluids of certain densities, but are too well known to require notice here. They occur altogether independent of organised structures, and must be regarded as in their nature purely physical.

2*d*, The peculiar movements observed in the interior of cells vegetable or animal, and during the putrefaction of organic matter. The former are seen in the large vegetable cells of the Chara, Vallisneria, and Tradescantia, among plants; and those of chyle, the yolk of the egg, and of the salivary cell among animals. The author had frequently watched the formation of the latter in putrid fluids. A scum composed of molecules collects on the surface; gradually several of these unite in minute filaments more or less long, which assume vibratile or serpentine movements. They are then called *vibriones*. It has been much disputed whether this class of molecular motions be physical or vital.

3*d*, The movements which are unquestionably vital that occur in the molecules of the yolk, on the entrance into the ovum of the spermatozoid. Here it cannot be maintained that the results are purely physical, because in different ova we see such widely varying

effects from apparently the same cause. Neither can it be attributed to any direct influence of the cell or of its nucleus, the germinal vesicle. For example, an egg is fully maturated in the female organs of generation, and would prove abortive if a spermatozoid did not find its way through the zona-pellucida and get among the molecules of the yoke. As soon as it does so, the apparently purposeless Brunonian movements receive a new impulse and direction. Both spermatozoid and germinal vesicle are dissolved among them, and that wonderful phenomenon of the division of the yoke takes place, not by cleavage or other action of the cell wall or nucleus, but by the separation of the mass into two masses instead of one. This was compared to what is observable in a dense crowd of men, called upon to pass over to the right or left hand in order to settle any disputed question by a majority. At first unusual confusion is communicated to the whole; some hurry in one direction, others in another; but after a time there is seen at the margins, where the crowd is least dense, a clear space, which gradually approaches the centre, and at length bisecting the whole, produces a complete segregation of the crowd into two portions. So with the molecules of the yolk in the egg after impregnation; their movements are directed by conditions which did not previously exist, and a stimulus is imparted to them which causes the peculiar result. It is the division and subdivision of the yolk, wholly or in part, which produces the germinal mass out of which the embryo is formed, and this not by any direct influence of the cell or nucleus, but in consequence of a power inherent in the molecules themselves, which was communicated to them for a specific purpose.

4*th*, The peculiar movements so well described by Brücke, Von Wittich, Harless, and especially by Lister, in the pigment cells of the frog's skin;* and which occasion the sudden change of colour in the cameleon, in fishes, and numerous other animals. The black pigment molecules may be diffused throughout the cell or concentrated in a mass, and all kinds of intermediate gradations may exist between diffusion and concentration. The change in colour is owing to these alterations in the molecules, the tint being light when they are concentrated, and dark when they are diffused. Mr Lister ascertained by experiment that their concentration is caused by ex-

* On the Cutaneous Pigmentary System of the Frog.—Philosophical Transactions, 1858.

posure to light, by death of the animal, and by sudden section of the nerve going to the skin—while darkness and irritation of the nerve or skin causes diffusion. Sudden amputation of a limb produced at first diffusion, followed by the concentration of death. These movements of the pigment molecules are peculiarly vital, and altogether independent of the cell wall or nucleus. The cell wall is stationary, and acts only as a sac or investing membrane around the moving particles, while the concentration of these about the nucleus is purely accidental, and frequently occurs in other parts of the cell. The author had seen these molecules himself, as Mr Lister describes them, streaming out to and returning from the circumference under the influence of the stimuli referred to, where no cell nor nuclear action could be thought of.

5th, There are many other kinds of movements which are evidently independent of cells: for example, those of cilia and of spermatozoids. The former are outside cells, and the latter only move when they are liberated from cells. The contractile fibrillæ of muscle are evidently not dependent for their inherent power on cells or other form of structure, but on the square-shaped molecules of which its substance is composed. All these phenomena, therefore, are connected with the molecules themselves; the force occasioning them is a molecular force, and has nothing to do with pre-existing cells, or supposed germinal centres, as some have imagined.

Again, the power of combination between these molecules, which, under peculiar conditions, not only move, but so move as to advance towards and press upon each other, that they at length unite and produce higher forms, must also be attributed to a molecular force operating in obedience to fixed laws. Thus it was demonstrated by Newton, that in a sphere the total attraction resulting from the particular attraction of all its component parts, is, as regards any body drawn towards it, the same as if they had been concentrated at the centre. Hence minute spherical particles, as so many gravitating points, will be drawn towards each other with a force varying inversely as the squares of the distances between their respective centres. The author referred at length to the able descriptions of Mr Rainey,* as to the physical laws regulating the formation and disintegration of bodies by molecular attraction and repulsion as well as to the effects of molecular superposition, showing that the same

* *Op. cit.* See also papers in the Microscopical Journal, 1860.

physical power which leads to the formation of these artificial bodies, when long continued, causes their disintegration and destruction. All these changes occur slowly, and require time; but their contemplation, when regarded as purely physical phenomena, must strike us with surprise, as being closely allied to all our conceptions of the progress of life itself.

Here the author explained, that in making use of the expressions *life* and *vital action*, he was only using terms to indicate phenomena which, in the present state of science, cannot be accounted for by the ordinary laws of physics. Or it might be said that certain actions are directed and governed by conditions which are as yet undetermined, but which, as they only occur in organic, as distinguished from inorganic bodies, constitute vital actions. Not that an organised body is independent of physical forces, but that certain directions are communicated to them; which, as invariably resulting in specific forms or properties, make up the sum of what we call vitality.

Hence, although we see molecules combining in the forms of crystals and nucleated spherules, inasmuch as we have discovered the physical conditions on which they depend, and can produce them artificially, we have no difficulty in classifying these among purely physical phenomena, even when they occur in the interior of animals. But when other molecules unite to form nuclei, cells, and fibres, and these arrange themselves into tissues and organs to produce plants and animals, we are ignorant of the conditions by which these results are brought about—we cannot imitate them artificially, and are content to call them vital. But the fact the author was anxious to point out was this, that so far as observation and research had enabled us to investigate this difficult matter, it would appear that the formations and disintegrations of vegetables and animals, as well as the peculiar properties they exhibit, are essentially connected with the molecular element. Thus, when we investigate the functions of plants and animals—for example, generation, nutrition, secretion, motion, and sensation,—we find them all necessarily dependent on the permanent existence and constant formation of molecules.

Thus generation, both in plants and animals, is accomplished by the union of certain molecular particles called the male and female elements of reproduction. Among the Protophyta, the conjugation of two cells enables their contents, or the endochrome, to mix together. This endochrome is a mass of coloured molecules, and the

union of two such masses constitutes the essential part of the generative act. In the Cryptogamia, a vibratile antheroid particle enters a germ cell, and finds this last filled with a mass of molecules which, on receiving the stimulus it imparts, assumes the power of growth. It is the same among the Phanerogamia, when the germ-cell is impregnated by the pollen tube. In all these cases it is necessary to remember that the protoplasm is a mass of molecules; that a spore is another mass of molecules; that sporules are molecules; that antherozoids are only molecules with vibratile appendages; and that the so-called germinal matter of the ovule is also nothing but a mass of molecules. Cell-forms are subsequent processes, and once produced may multiply endogenously, by gemmation or cleavage; all that is here contended for is, that the primary form is molecular, and that the force-producing action in it is a molecular force.

In animals, as in vegetables, every primary act of generation is brought about by the agency of molecules. The Protozoa entirely consist of mere molecular gelatiniform masses, in which it has never been pretended that a cell wall or central cell exists. And yet such masses have the power of independent motion, and of multiplying by gemmation. Considerable discussion has occurred as to whether, among Infusorians, there is a union of sexes or a conjugation similar to what occurs among the Protophyta; but in either case, it is by molecular fusion that the end is accomplished. In the higher classes of animals there are male elements, consisting of molecules, generally with, but sometimes destitute of, vibratile filaments, and female elements, composed of the yolk within the ovum, containing a germinal vesicle or included cell. Both spermatozoid and germinal vesicle are dissolved in the molecules of the yolk, which then, either wholly or in part, by successive divisions and transformations, constitute a germinal mass out of which the embryo is formed. Here, as in plants, it is necessary to remember that the spermatozoids, the yolk, and the germinal mass, are all composed of molecules, and that these, combining together, form the nuclei, cells, fibres, and membranes which build up the tissues and organs of the organism. It is not from either the male or the female element that the embryo is formed. The supporters of an exclusive cell doctrine have endeavoured to show that there is always a direct descent either from the wall of the ovum or from the germinal vesicle as its nucleus. Thus some consider that the vitelline membrane sends in partitions to divide the

yolk mechanically. Others have formed the idea that the germinal vesicle bursts, and that its included granules constitute the germs of those cells which subsequently form in the germinal mass. Others, again, suppose that on impregnation the germinal vesicle divides first, and that the molecules of the yolk are attracted round the two centres so formed. But numerous observations had satisfied the author that both spermatozoid and germinal vesicles are simply dissolved among the molecules of the yolk, from the substance of which, stimulated and modified by the mixture so occasioned, the embryo is formed; a view which has further the merit of explaining what is known of the qualities of both parents observable in the offspring. He was only acquainted with one exception to this general law, viz., the development of *Pyrozoma*, recently described by Mr Huxley, the description of which, however, was incomplete.* The truth appears to be, that in an analogous manner to that in which the pigment molecules of the skin are stimulated by the access of light to enter into certain vital combinations with one another, so are the molecules of the yolk stimulated by the access of the spermatozoid to produce those other vital combinations that result in a new being. The essential action is not so much connected, as has hitherto been supposed, with the cell wall or nucleus as with the molecular element of the ovum.

With regard to nutrition—food and all assimilable material must be reduced, in the first instance, to the molecular form, while the fluid from which the blood is prepared, viz. chyle, is essentially molecular. Most of the secretions originate in the effusion of a fluid into the gland follicle, which becomes molecular, and gives rise to cell formation. In muscle, the power of contractility is inherently associated with the ultimate molecules of which the fasciculus is composed; and lastly, the grey matter of the sensory ganglia, and of the brain, which furnishes the conditions necessary for the exercise of secretion, and of even intellect itself, is associated with layers of molecules which are unquestionably active in producing the various modifications of nervous force. These molecules are constant and permanent as an integral part of these tissues, as much as cells or fibres are essential parts of others, and their function is not transitory, but essential to the organs to which they belong.

All these facts point to the conclusion that vital action, so far

* Annals of Natural History, Jan. 1860, p. 35.

from being exclusively seated in cells, is also intimately associated with the elementary molecules of the organism.

III. This leads me, in the third place, to an enunciation of the molecular law of growth, which a study of the numerous facts previously referred to has induced me to frame, viz.:—*That the development and growth of organic tissues is primarily owing to the successive formation of histogenetic and histolytic molecules.* We have already seen that development and growth in animals originate in the molecules of the yolk of the egg, or of a germinal molecular mass formed from it. The author referred to numerous careful researches recognised by scientific men as giving a correct account of the development of various animals and textures. From these it would appear that the first form was molecular; that the molecules united to produce nuclei and cells; that these became disintegrated to produce a secondary mass of molecules; that these again united to form secondary nuclei and cells; and that the same process was repeated more or less often in various developments, until the animal or tissue was formed. This constituted the successive histogenetic and histolytic molecules observable in the process of growth,—the former building up, to a certain extent, and the product disintegrating to produce the latter, which after a time, again, re-arranged itself and became histogenetic to form cells or tissues, which in their turn broke down and became histolytic. In short, not only development, but growth and secretion, absorption and excretion, were only different names given to histogenetic and histolytic processes, and that these were brought about by formative and disintegrative molecules. As illustrations of this law, the author minutely followed the development of *Ascarix mystax*, as described by Nelson,* and of the process of nutrition in the human body.

In this, and a vast number of similar observations, it must be evident that a certain series of molecular transformations is necessary for the one which follows it. Thereby is produced a continual elaboration of matter,—a constant chemical and morphological series of changes,—the exact number and order of which, in the production of organic forms, only requires time and perseverance to discover. Doubtless various conditions, dynamical, chemical, and vital, must co-operate in producing the result, and they must all influence mole-

* Philosophical Transactions, 1850, plates xxviii., xxix., figs. 59, 68, 70, 78.

cular as well as every other kind of combination. Such considerations and facts must convince us of the error of endeavouring to place the source of special vital action in any particular form or arrangement of organic matter, whether fibre, cell, nucleus, or molecule. Each and all of these elements, the author contended, had their vital endowments, which re-operate on the others. But, inasmuch as the molecular element is the first as well as the last form which organised matter assumes, it must constitute the principal foundation of organisation itself.

The author pointed out that it was not his object, in directing attention to a molecular theory of organisation, to interfere in any way with the well-observed facts on which physiologists have based what has been called the Cell-theory of growth. True, this last will require modification, in so far as unknown processes of growth have been hypothetically ascribed to the direct metamorphosis of cell elements. But a cell once formed may produce other cells by buds, by division, or by proliferation, without a new act of generation, in the same manner that many plants and animals do, and this fact comprehends most of the admitted observations having reference to the cell doctrine. The molecular, therefore, is in no way opposed to a true cell theory of growth, but constitutes a wider generalisation and a broader basis for its operations. Neither does it give any countenance to the doctrines of equivocal or spontaneous generation. It is not a fortuitous concourse of molecules that can give rise to a plant or animal, but only such a molecular mass as descends from parents, and receives the appropriate stimulus to act in certain directions.

In conclusion, the author remarked that the theory he had endeavoured to establish on histological and physiological grounds, is fully supported by all the known facts of disease and of morbid growths, which further serve to show that pathology, so far from being cellular, is in truth molecular.

2. Notices of Early Scotch Planting. By Prof. Cosmo Innes.

The common opinion that Scotland was at one time closely wooded, is at least questionable, and some circumstances lead to an opposite belief: as,

The careful stipulations found in the most ancient deeds, about giving or withholding a limited use of wood for building and fuel.

The use of foreign timber for our greater buildings, when to be had; thus, Norway timber used for building the Abbey of Arbroath, in the 15th century.

The importation of bow-staves and spear-shafts, such long straight timber not being procurable at home.

The trees found in peat-mosses, for the most part small and few, and confined to narrow spaces, by no means prove a general covering of wood in ancient times.

One reason of the common error is the change of meaning which the word *forest* has undergone. From its etymology, the word has no connection with wood, and of old, and especially with old lawyers, it meant merely land privileged for the chase; but many people, meeting the word in old charters and descriptions of estates, suppose it to mean as at present, wood-land.

It is clear, however, that there has always been some wood, even timber, in Scotland.

The earliest Christian churches were of timber, probably in all countries; and the building of churches of stone was considered a novelty at the beginning of our acquaintance with church architecture in Scotland.

The forts built in inland lakes and morasses, which the Irish have taught us to call *cranogues*, of great antiquity, perhaps the most ancient extant dwellings except caves and burrows, are found often built on piles of oak of moderate size, and sometimes with beams of birch for the cross timber.

Sometimes beside these forts, but often apart, are found the shells of rude but large canoes, bespeaking a high antiquity, each hollowed out of a single oak.

Within the period of history (A.D. 1249), the Earl of St Pol and Blois, preparing for the Crusades, had a wonderful ship (*navis miranda*) built at Inverness.

The Bishop of Caithness, Chancellor of Scotland, and a friend of Edward the First, being engaged (A.D. 1291) in putting a roof on his cathedral of Dornoch, obtained from the king a grant of 40 oaks, fit for timber, to be taken out of the wood (*bosco*) of Darnaway, in Moray.

The Bishop of Brechin granting (A.D. 1435) a lease of the Kirkdavoch of Strachan for three lives, took the tenant bound to deliver, not periodically, but once only, oak laths enough for roofing

20 perches of the cathedral, or the Bishop's palace—*tantas vulgariter dictas lathis bonas et sufficientes de quercu.*

Two centuries later (1606), Alexander Davidson, styled tymberman in St Andrews, agrees with "the honest man that has bocht the wod of Drum, for als mekill tymber as will big ane bark." The timber was to be floated down the Dee, "how soon the water growis." This was evidently fir-timber. Nine trees were bought from the woodmen of Drum (1612–13) to make a sluice for one of the town of Aberdeen's mills, for the price of £27. These may have been oak.

The presumption seems very strong, from the present appearance of the ground, and all circumstances, that the timber in all these transactions was not planted, but of the native growth.

From all the evidence we have, old historical Scotland,—Scotland of the 14th to the 17th century, both included,—in regard to wood was very much as at present; making allowance, however, for the effect of cultivation which has curtailed it a little, and plantation, which has immensely increased its quantity in the last century. Speaking generally, the levels were cultivated, or bare moorland or swamp; the upland pastures, whether green or heathery, were bare of wood, except where the steep and rough glens, ravines, and water-courses, sheltered and protected from cattle a fringe of native wood—hazel, birch, or oak—the latter of small size. There are, and always have been, districts more or less willing to send up a native growth of timber—as Braemar; the upper part of Strathspey; the upper part of the valley of the Beauly; parts of Glenmoriston, and Loch Arkeg in Lochiel.

To remedy the defect of wood, some of our old codes of criminal practice appointed a form of procedure against trespassers and destroyers of wood; and the parliamentary records of Scotland are full of ordinances to encourage planting of wood, and even broom, in minute quantities; and for the repression of offences against it.

Following out the intention of the Legislature, the great proprietors had made some efforts at planting in the 15th century.

The Abbot of Cupar (A.D. 1473) set in lease the lands of Balmyle, in Strathmore, and bound the tenants to "put al the land to al possibil policie in biggin of housis, plantacioun of treis—*eschis*, *osaris*, and *sauch*, and froit-treis—gif thei ma."

From that time downwards, there are documentary proofs of some

attention bestowed upon planting in Scotland; and, in a few, widely-scattered instances, we find places bearing marks of culture and planting that carry us back to that century; but all of these mark, also, that the effort was confined to the planting of a few trees near the mansion-house and the houses of the greater tenants.

In the next century (16th), but rather towards the end of it, considerable progress was made in the creation and embellishment of country houses. William, first Earl of Gowrie, who built a gallery, and decorated it with pictures, was a zealous planter, and was fond of the chestnut and walnut. In 1586, James, Lord Ogilvy, is found corresponding with Sir David Lindsay of Edzell, about their plantations, and writes to him—"Your thousand young birkis shall be richt welcom."

At the same period the Campbells of Glenurchy were creating the place of Balloch, now Taymouth, enforcing the planting of single trees amongst their tenants, and using vigorous measures for protecting wood. Probably similar operations were carried on in that century at Seaton, at Winton, Lethington, and other places; and some remains of still older cultivation are to be found about the seats of the old Church lords, as at Newbattle, Ancrum, Pinkie, and a few others.

It seems very doubtful whether any tree planted before the Reformation is now growing in Scotland. The date of the sycamore at Kippenross is not well vouched; and, to judge from appearance, neither it nor those at Newbattle can be ranked so old as 300 years. The chestnut at Finhaven was certainly much overrated when said in 1760 to be 500 years old.

Some ancient yews, especially the yew of Fortingall, come under a different category. It would appear that successive trees grow up in the bark and round the stem of the decayed yew, and may go on decaying and reproducing indefinitely.

About the period of King James's accession to the English throne (A.D. 1603) was the era of a great effort for improving and beautifying our country mansions, as shown in the Aberdeenshire castellated mansion, and others of the same taste all over Scotland. That period of fine taste was marked by great attention to planting, chiefly in the manner of avenues of ash and sycamore, with a timid intermixture of chestnut and walnut. During "the troubles" of Charles's reign and the Commonwealth, there was a cessation of progress;

but yet even in that time we find the Earl of Lauderdale sending to Taymouth for fir seed, and the Marchioness of Hamilton expressing her own interest, and that of several of her relations, in young firs grown from Breadalbane seed, and boasting that she had four or five hundred of her own planting. "Believe me," says she, "I think mair of them nor ye can imagin, for I loue them mair nor I dou al the froit-treis in the wordil." The Restoration (1660) brought a great change. Crowds of young men, virtually exiled during the Usurper's reign, then returned from wandering over the Continent, where they had learnt to admire the taste of the Italian villa and the French chateau. Evelyn tells us how universal the passion for rural embellishment and magnificent country houses was among the English nobility, and he himself helped to extend the public attention to restoring and planting wood.

Scotland kept pace as much as her poverty allowed. The botanical garden of Edinburgh was founded (1670). Country-seats were built or restored, and planting was carried on in many places where we can yet find trees to be ascribed to that period—still chiefly in the limited style of straight avenue and hedgerow. This was the date of a great enlargement—almost new modelling—of Taymouth, Hatton, Inverary, Drumlanrig, Hamilton, Hopetoun, Panmure, Kinross, Yester, Arniston, with a long *et cetera.*

The Revolution (1688) may be said to have renewed the impulse given by the Restoration. Again, a crowd of Scotch gentlemen whom the unhappy courses of the last Stuarts had driven abroad, returned to their own country, imbued with the taste of cultivation they had acquired in Holland and Flanders. Among these were Hume of Marchmont, the Dalrymples, Lord Haddington, Dundas of Arniston, Argyll, Hyndford, &c.

About this time a style of planting became fashionable, breaking a little from the formal straight avenue, and which was known as "the wilderness." The Earl of Mar at Alloa, his brother Lord Grange at Preston, Lord Haddington, and the First President Arniston, adopted this style; and at Arniston is preserved a plan of "the wilderness" as it was in 1726, which can still be distinctly traced on the lawn to the west of the house, and shows how little the original formality impedes the picturesqueness of the grown wood. There was a wilderness also at Blair-Atholl.

Lord Haddington remarks that planting was little understood in

Scotland till the beginning of the 18th century (1700), and, of planting in masses, the remark is nearly correct. He himself was among the first who planted on the great scale, and with method and discrimination. But a little before his time (A.D. 1680) Andrew Heron was planting at Bargally, in the stewartry of Kirkcudbright, which Loudon considered "the most interesting place in Scotland with respect to the introduction of foreign trees and shrubs." Dukes John and Archibald of Argyll followed, bringing their English experience to bear on Scotland. Lord Haddington and his wife made the noble wood of Tyningham out of a rabbit-warren. The Earl of Bute, Lord Loudoun, and Lord Hyndford, were planters in the most favourable situations of Scotland. The Earl of Panmure planted endless beech avenues at Panmure, which within memory were grand and growing trees, and proved how the East Coast may be made to produce fine timber.

It has been said by old foresters that Panmure and Yester were the two places where beech was first planted largely. The taste spread rapidly. It was from Lord Tweeddale that the first President Dundas brought a present of thirty beech plants and one elm, which were carried in his portmanteau, on his servant's horse, to Arniston. The beeches are still standing and flourishing in the south avenue. They bear the marks of having been headed down in transplanting —a practice of that time.

Next came the taste for larch, which must have been introduced in several places as soon as at Dunkeld, though the story of the Duke's two flower-pot larches (A.D. 1727) may be true too.

A few giant larches at Arniston may be as old, and one or two in the "Paradise," by the river side at Monymusk, are apparently coeval, as they are coequal, with the finest trees at Dunkeld.

In the north country the Duchess of Gordon (the Mordaunt Duchess) was a great improver, and planted to some extent both at Gordon Castle and in Strathspey. Sir William Gordon of Invergordon planted and drained extensively; and other improvers and planters of that time were Ross of Balnagown, the Grants of Monymusk, Scott of Scotstarvet, Hope of Rankeillor, Lord Cathcart, Sir Francis Kinloch, Sir John Dalrymple, Wauchop of Edmonston, Sir James Dick of Priestfield, Sir James Stewart of Goodtrees, the Duchess of Buccleuch, Sir James Cunninghame, Lord Livingston.

Reid's "Scots Gardener," published in 1683, shows the taste for wood already begun. Sir Archibald Grant of Monymusk has left us a brief but interesting account of the planting and other improvements begun by him in 1716. The Earl of Haddington published, in 1733, a minute account of his planting operations. At Arniston are preserved original accounts and contemporary documents showing the extent and manner of planting there during almost the whole of last century, and also a narrative detailing the results made up from such materials, written by the Lord Chief Baron Dundas. An anonymous writer in 1729 (believed to be Mr M'Intosh of Borlum) mentions a good many improvers, enclosers, and planters, in Scotland at that time. Mr Walker, Professor of Natural History at Edinburgh, in his "Economical History of the Hebrides and Highlands," and his collected "Essays," gives the results of his own observations of trees through Scotland, from about 1760, for twenty years. Sang's "Planter's Calendar;" Dr Patrick Graham's "General Report of Scotland;" Monteith's "Forester's Guide;" Sir Thomas Dick Lauder's edition of "Gilpin," furnish a considerable mass of information of the state of wood in Scotland during a century past. And Loudon, in his most laborious and valuable "Arboretum et Fruticetum Britannicum," arranges and digests much of these materials. One important use served by the authors named is to enable us to compare the present condition and size of trees with what they were at ascertained distances of time previous; while the collection of returns of remarkable trees now making to the Highland Society, will serve as a foundation for such measurement and comparison in future times.

The following Gentlemen were admitted Ordinary Fellows:—

Thomas Herbert Barker, M.D.
Robert MacLachlan, Esq.
James Young, Esq.

The following Gentleman was admitted an Honorary Fellow:—

Sir W. E. Logan, Director of the Geological Survey of Canada.

The following Donations to the Library were announced:—

Original Sanscrit Texts on the Origin and History of the People of India. By J. Muir, D.C.L. Part Third. 8vo, 1861.—*From the Author.*

Résumé Meteorologique de l'année 1859 pour Genève et le Grand Saint Bernard. Par E. Plantamour. 8vo.—*From the Author.*

Observation de l'Eclipse Totale de Soleil du 18 Juillet 1860. Par E. Plantamour.—*From the Author.*

Observations Astronomiques faites a l'Observatoire de Genève (1855-56). Par E. Plantamour. 4to.—*From the Author.*

Mesures Hypsometriques dans les Alpes. Par E. Plantamour. 4to.—*From the Author.*

Journal of Proceedings of Linnean Society, Vol. V. No. 19.—*From the Society.*

Almanaque Náutico para 1862. Cádiz, 1860. 8vo.—*From the Observatory of St Fernando.*

Monday, 15*th April* 1861.

The Hon. LORD NEAVES, Vice-President, in the Chair.

The following Communications were read :—

1. Additional Observations on the Chronology of the Trap-Rocks of Scotland. By Archibald Geikie, Esq., F.G.S.

In a communication made to the Society last session, the author stated the results of a series of explorations among the trap-rocks of Scotland, and showed that, at successive periods, during the deposition of the Lower Silurian, Old Red Sandstone, Carboniferous, Oolitic, and Tertiary formations, there were contemporaneous eruptions of volcanic material. During the year 1860, the investigation was continued across the Highlands into the Inner Hebrides, and throughout a large part of the central counties southward to the Cheviot Hills. The author was now able to fill in more fully what had only been sketched in outline in the previous paper, and to prepare a series of maps to illustrate the volcanic areas of Scotland during the successive geological periods. He showed that, in the Scottish Highlands, no distinct trace existed of any igneous rock erupted contemporaneously with the deposition of those Lower Silurian strata which are now metamorphosed into gneiss, mica-schist, clay-slate, &c. The greater part of his observations during the past year had been devoted to the elucidation of the chronology of the igneous rocks belonging to the period of the Old Red Sand-

stone, and he found that, in central Scotland, that formation exhibited a copious series of contemporaneous felstones and ash-beds in its lower and upper members; the former being exemplified in Forfarshire and Perthshire, and the latter in Fife and in the Pentland Hills. Several additional facts had also been observed among the Carboniferous trap-rocks, tending to make the series more complete, and to show how with volcanic movements there were associated certain risings and sinkings of the land, whereby the fauna and flora of the Carboniferous period were locally modified. Reference was also made to the remarkable series of greenstone and basalt dykes which traverse Scotland from N.W. to S.E., and enter the northern English counties. From observations made at either end of the series, the author deduced the inference that these dykes are later than the Lias, and probably belong to the period of the Middle or Upper Oolite.

2. Notes on Ancient Glaciers made during a brief Visit to Chamouni and its neighbourhood in September 1860. By David Milne-Home, Esq. of Wedderburn.

With reference to the *Mer de Glace*, the author described the great transported blocks on the slope of the hill above Montanvert Inn; the smoothed rocks about 250 to 300 feet above the glacier; the two ancient lateral moraines on the east side of the valley; the action of the ice on a perpendicular wall of rock near foot of glacier; the old moraine of Lisboli, which must have formerly crossed and blocked up the valley, and the transported blocks on the hill of Flegère, about 2700 feet above Chamouni, and probably deposited there by glacier, when it was at the level of the blocks above the Montanvert.

The hill of Chavant was next described, situated about six miles west of Chamouni, on the north side of the valley, the south slopes of which are beautifully smoothed and scratched to the top of the hill, which is 1000 feet high. The scratches in some places inclined at an angle of 15° to 20°; their direction near foot of hill, W.N.W.; about midway up, N.W.; and near top N.N.W. by compass.

On west side of valley, opposite to Chavant, at the Hameau of Le Grange, there are rocks of soft schist, flattened, smoothed,

furrowed, and scratched. In several places there are veins of hard quartz standing three or four inches above the general surface of the smoothed rocks, on the south side of which veins the furrows generally stop, as if the furrowing agent had been obstructed by them. A model illustrating the phenomenon was exhibited. The direction of the furrows and scratches is here due N. and S. The locality is 1300 feet above Chamouni, and 4725 feet above the sea.

It was mentioned that transported alpine blocks occur on both sides of the valley here, and all the way down to the Petit Salève mountain (near Geneva), distant about thirty miles, the S.E. slope of which faces the Arve valley. These blocks cover the hill to its top, which is 2800 feet above the sea.

The author mentioned having visited the glaciers in the higher parts of Chamouni valley, and that he had satisfied himself of the fact that an ancient glacier had passed northwards into the Val Orsine. He considered that the whole of the upper part of Chamouni valley had been filled with ice, which had flowed, not down that valley, but through the Val Orsine. The pass into this valley must at that time have been at least 1000 feet lower than the obstruction across the valley of Chamouni caused by the Mer de Glace.

Some account was then given of the marks of ancient glaciers in the valley of the Rhone; and attention was more particularly drawn to the enormous deposits of gravel, sand, and clay throughout low Switzerland, and to the important fact, that the great transported blocks on the Jura, and elsewhere in low Switzerland, are generally imbedded in these pleistocene strata.

It was also mentioned that the transported blocks are at greater absolute heights near the mouth of the valley of the Rhone than anywhere else; and that these heights, both for the blocks and for the gravel and clay beds, diminish gradually towards the west. The sloping line of the latter along the south bank of Lake Leman is a striking object from Lausanne.

The author expressed his conviction, from the phenomena referred to, that glaciers had formerly descended to the low country through the valleys of the Arve and Rhone, bringing down and spreading in all quarters blocks and detritus. The only difficulty felt was as to the cause of the low temperature necessary to produce glaciers on so great a scale.

He was inclined to the opinion, that at the time of this low temperature, the whole of Switzerland had stood 3000 feet higher above the sea than at present; the effect of which would be to produce at Geneva a temperature equal to that now prevalent at the places where the alpine glaciers melt.

In support of this view, he referred to the upheavals and depressions of this part of Europe, before and after the transportation of the blocks. The former is established by the dislocation and slope of the beds of *molasse,* a deposit which immediately underlies the gravels and blocks of the great glacial period. The latter is established by the stratification of the glacial detritus into regular beds, mostly horizontal, and in very many instances enveloping transported blocks.

His notion of the sequence of events was therefore as follows:—

1*st*, Switzerland elevated 3000 feet higher than at present; at which time the molasse beds were fractured and thrown into steep slopes. The temperature of low Switzerland would then be low enough to allow the glaciers to descend as far as the Jura; and the whole country would then be overspread with glacial detritus.

2*d*, A submergence of Switzerland under the sea, to the extent of 3000 or 4000 feet lower than the existing levels, followed, when the glacial detritus would be arranged into horizontal beds of gravel, sand, and clay.

3*d*, A re-elevation of the country to the present levels took place, since which event, the pleistocene strata in the valleys have been scoured out by the action of the rivers.

Monday, 29*th April* 1861.

PROFESSOR ANDERSON, in the Chair.

The following Communications were read:—

1. On the Aqueous Origin of Granite. By Alexander Bryson, P.R.S.S.A.

In this paper the author referred to the labours of Dr William Smith, who published his "Tabular View of the British Strata" in 1790, and remarked that since that period geology had been studied mainly in the direction of Palæontology. Physical, chemical, and

dynamic geology, were left almost unregarded by the great masters of the science, who generally accepted the speculations of Hutton and the experiments of Hall, as demonstrating the igneous origin of the primary rocks.

The author stated that the Huttonian theory was most ably attacked, and, in his opinion, overthrown by Dr Murray in his "Comparative View of the Huttonian and Neptunian Systems of Geology," a work most unaccountably overlooked. Since that time it had suggested itself to the sagacious mind of Davy, that the occurrence of fluids in the cavities of crystals seemed to point to an aqueous origin. He also alluded to the writings of Brewster, Sivewright, and Nicol, in the same field; also to Becquerel, Fuchs, Bischoff, and Delesse, who have taken up the subject of the aqueous origin of rocks from a chemical point of view. The author then laid before the Society the result of ten years' experimental investigation into the structure of rocks relative to their formation, more particularly granite. While examining microscopically the various pitchstone veins abounding in Arran, he was much struck with the similarity of their structure, and the marked difference they exhibited when compared with sections of granite and its various mineral constituents. On extending his observations to obsidian, marekanite (a volcanic glass from Lake Marekan in Kamtschatka), and also to the well-known glassy obsidian of Bohemia, he found they all exhibited a structure analagous to the pitchstones of Arran. He further found that sections of glass slags, where the heat had been long continued, combined with slow cooling, all presented the same appearances as the sections of pitchstone.

This structure, peculiar to igneously formed substances, he found usually to radiate in a stellate form; and though many slags showed large stars visible to the naked eye, the stellate structure is more easily observed by the aid of the microscope. The character is so marked that no one whose eye is tutored to microscopic observation can fail to recognise at once a mineral substance of igneous origin.

In granite, on the other hand, the structure, as seen by the microscope, is as persistent as in pitchstone, glass, and obsidian, but totally different.

In the many experiments which the author had tried with granites from various localities, he had never succeeded in obtaining one instance of stellate structure, while the constant occurrence of

cavities containing fluids convinced him that, if pitchstone and glass are types of igneous-formed substances, granite must be of aqueous origin. In the fluid cavities so abundant in topaz, Cairngorum, beryl, tourmaline, and felspar, all constituents of granite, he found the same appearance prevailed. These cavities are seldom entirely filled with fluid, an air-bubble usually occupying more or less of the cavity. After many hundred experiments on such cavities, the author found that when exposed to a temperature of 94° Fahr., the bubble disappeared, the fluid entirely filling the cavity, and at the temperature of 84° the bubble reappeared with a singular ebullition, showing that the air had formed an atmosphere round the fluid. He was thus led to infer that those cavities could not have been filled at a temperature above 84°, and certainly not above 94° of Fahrenheit.

As another proof that these cavities could not have been filled when the temperature of the surrounding rock was higher than the temperature above indicated, the author drew attention to the fact, that the bubble of air occupied always a much smaller portion of the cavity than the fluid, a condition which could not obtain, if, as other writers hold, the fluids were enclosed under intense heat and pressure.

For the purpose of accurately determining the temperatures at which the bubble vanished and reappeared, the author constructed an apparatus which he exhibited and described. It consists of a microscope with a hollow iron stage, having a tube in the centre to admit light from the reflector. At one side, and inserted into the stage, is a small tin retort with a stopper; at the other side, a tube is inserted and attached to a reservoir of water, from which the hollow stage and retort are filled. On applying heat to the retort, by means of a spirit-lamp, any required temperature under the boiling-point of the water may be obtained in the stage and retort.

Above the stage is placed an iron saucer, in the centre of which an iron tube is rivetted, through which the light is admitted; this vessel is filled with mercury, and in it is placed an upright thermometer, with the bulb shielded with cork or any other good nonconductor; by this means it indicates the actual temperature of the mercury bath. The cavity to be observed is cemented with Canada balsam to a plate of glass 3×1 inch, and is floated on the surface of the mercury, so that the glass and mercury are in absolute con-

tact. When the temperature is raised until the bubble nearly disappears (which is seen by its contraction), the spirit-lamp is withdrawn, and the vanishing point carefully watched, and the temperature noted. The stopper of the retort is then withdrawn, and the stop-cock of the reservoir of water opened, so that the temperature of the stage and mercury bath is soon reduced, and the ebullition or reappearance of the bubble takes place, when the temperature is again recorded. By this method the author felt confident that his results were correct, as they always were consistent when observing the same cavity. By means of this instrument the author had found fluid cavities in the trap tuffa of Arthur's Seat, the greenstone of the Crags, and the basalt of Samson's Ribs. He had also found that the porphyry of Dun Dhu in Arran, which most geologists assumed as of igneous origin, was full of fluid cavities contained in the doubly acuminated crystals of quartz for which this remarkable porphyry is distinguished. He also showed doubly acuminated crystals of quartz in the saliferous gypsums of India, both of which were full of fluid cavities, and the quartz impressed with the gypsum; and as no geologist would hold that this formation was of igneous origin, but that the quartz, if not contemporaneous with the gypsum, must have been subsequent, and as the same phenomena were presented by the porphyry of Dun Dhu, he was forced to the conclusion that it was as much aqueous in its origin as the saliferous gypsum of India. The author exhibited a specimen of quartz which contained a crystal of iron pyrites, to which was attached a crystal of galena and also a small massy zinc blende, while over these three metals was laid a covering of gold. From this specimen he argued, that as all these metals were fusible at a much lower temperature than quartz, they must have aggregated during a gelatinous condition of the quartz; and further, that as the sulphides of the three metals were in chemically combining proportions, any heat which would have fused the quartz would have made an alloy or a slag in which chemical combining proportions could not occur.

He also exhibited specimens of schorl which he had obtained in the granite of Aberdeen, and drew the inference that schorl, which crackles and splits with a very small increment of temperature, could not have been present during a molten condition of the quartz; and that it was crystallized prior to the solidifying of the

latter, as proved by the schorl impressing the quartz. The author, from a careful examination of the schorls in the quartzite of Aberdeen, was led to believe that the quartz, while in the process of crystallization, expanded one twenty-fourth of its bulk, a force which appeared to him to be sufficient to cause all the upheavals and disruptions which had led geologists to account for such phenomena by a molten condition of the primary rocks. If this view is correct, and if the highest peak is granite, as the lowest is known to be granite, the author calculated that as the highest mountain is only $\frac{1}{571}$ part of the radius of the earth, a thickness of the crust of 168 miles is quite sufficient to yield expansive force to raise the highest peak of the Himalayan range. He further stated that the cause of the temperature at which the fluids were confined being higher than the normal one, depended on the rise of temperature which takes place during solidification.

The author, in conclusion, trusted he would soon be in a position to confirm these views when he had finished the investigation of the trap rocks with which he is now engaged.

2. Notes of Excursions to the Higher Ranges of the Anamalai Hills, South India, in 1858 and 1859. By Hugh Cleghorn, M.D., F.L.S., Conservator of Forests, Madras Presidency.

The southern ranges of the Anamalai (*i.e.*, Elephant) Hills having been little explored, and only known through the manuscript report of Captain J. Michael, 39th N.I., formerly of the Forest Department, the author was induced to project an excursion to these heights, in concert with Dr D. Macpherson, Inspector-General of Hospitals, and the Collector and Engineer of the Coimbatore District (Messrs Cherry and Fraser). The arrangements were made under the auspices of the Right Hon. Lord Harris, Governor of Madras, and His Excellency Sir P. Grant, complied with the request that Major Douglas Hamilton, 21st N.I., should accompany them as artist, to delineate the characteristic features of the country. (This officer's sketches, seventeen in number, some of them panoramic, were exhibited. A selection will appear in the Transactions). Notwithstanding the unfavourable state of the weather, the result was not without interest, much additional information having been obtained,

which elucidates Col. Fred. C. Cotton's narrative of an expedition over the Anamalai mountains (northern range). (See "Madras Journal of Literature and Science," vol. ii. p. 80. 1857.)

The main results of the excursion were extracted from his Diary, beginning 15th Sept. 1858. "Teak occurred on some undulating knolls, two or three miles before reaching the village (Punáchi), and on the slopes of the basin leading to the river (Torakadu). The teak tree is not of superior dimensions, but is thickly scattered, forming nearly half of the forest. Many of the trees would yield second-class logs, and they increased in size as we descended the gorge. Being in flower, the white cross-armed panicles formed a striking feature in the landscape. There was much fallen and decaying teak within three miles of our huts. I inspected the jungle both in going and returning, and walked across in different directions to estimate approximately the number and size of the trees, and came to the conclusion that the value of standing wood might be 50,000 rupees, and of fallen timber at least 5000 rupees, a sum which could easily be realised, if there had been easy transport. We saw, farther up the valley, much Vengé (*Pterocarpus marsupium*) and blackwood, which became more abundant, as the elevation increased. These trees seem to prefer an altitude somewhat greater than teak, whilst the Vella Nága (*Conocarpus latifolius*), of great size, occurs with the teak, or prefers a lower range. The sholas (glades) near Punáchi, between 3000 and 4000 feet above the sea, are very dense and rich in their flora. The following are a few remarkable forms observed, a new species of *Jenkinsia* (Wallich), *Solenocarpus Indicus*, a tree called by the Kaders Palli-illi, the leaves of which are eaten. *Elœocarpus Monoceros*, a new species of *Cookia* (Mur Kuringi), with a delicious fruit. *Glycosmis pentaphylla*, *Pierardia macrostachys*, with an edible fruit. *Cleidion Javanicum* (Wall); *Mesua*, with very large fruit; *Calophyllum*, a species with narrow lanceolate leaves; *Orophea*, two new species; *Unona pannosa*, *Guatteria coffeoides*, *Cyathocalyx zeylanicus*; *Garcinia*, *Pterospermum obtusifolium*, *Sterculia guttata*, *Machilus*, *Casearia*, a new species; *Euonymus*, two apparently new forms, one with downy leaves, and the other much like a lime tree. *Agrostemma*, two species, *Ophioxylon*, a new species, with falcate bracts; and *Othomorphe subpeltata*. *Acranthera zeylanica*, *Nephelium erectum*, a

very gorgeous species of *Pachycentria*, and two rare Euphorbiaceous trees, *Dimorphocalyx glabellus*, and *Desmostemon zeylanicum*, lately described by Mr Thwaites.

"Many of the trees in the dark sholas are covered with beautiful epiphytes, especially the *Hoya pauciflora*, *Æschynanthus zeylanicus*, and *Sarcanthus filiformis*. The dripping rocks are adorned with *Klugia* (two species), *Epithema*, &c. Cardamoms with rich aroma, and the true ginger plant, abound in these sholas. The rocks in the bed of all the rivers, from 3000 to 4500 feet, are quite covered with a showy orange-coloured Balsam (*Impatiens verticillata*). It often forms a fringe at the line of watermark, or appears in patches between the forks of a cascade. At a higher elevation, other species seemed to take its place, especially the "*Impatiens Tangachee*" (Beddome). A truly aquatic fern, a new species of *Pleopeltis*, grows in great abundance on rocks at the bottom of the Torakadu river.

"The *Rhododendron arboreum* was first seen at an elevation of about 5000 feet."

Mr Beddome has favoured me with the following note of his ascent:—"The rocky Akka Mountain, which is probably upwards of 8000 feet, is quite covered near its summit with several new species of *Impatiens*. The only other new form observed on this mountain was a curious Crassulaceous plant with fleshy peltate leaves, growing in sheltered moist nooks of the rock. Balsams are very abundant on these hills. *Impatiens Balsamina, dasysperma, Hensloviana, maculata, Campanula, chinensis, tomentosa, verticillata, oppositifolia, Kleinii, filiformis, tenella*, and *rivalis*."

"Some of the herbaceous plants observed adorning the higher hill-side pastures were:—*Flemingia procumbens, Phaseolus Pulniensis, Anemone Wightiana, Lysimachia Leschenaultii* and *deltoidea, Utricularia, Ranunculus reniformis, Gentiana pedicellata*. This list might be extended, but the examples are sufficient to show the similarity of the Flora to that round Utakamand."

The general appearance and character of these high lands resemble much the Nilgiri Hills. Here are the same rounded eminences and dense sholas, extending continuously for miles, their edges fringed with *Strobilanthes*, and ceasing abruptly; the hills are conical, and the slopes covered with short, rich grass, abounding with such plants as *Exacum bicolor*, and *Ophelia elegans*: the woods

contain *Hymenodyction excelsum*, and other species of the Cinchona family. Heavy rains, evidently the breaking up of the south-west monsoon, fell continuously during the period of our stay in these upper regions. The want of shelter, and the difficulty of procuring supplies, prevented us from proceeding to the highest parts of the range, which appeared to be about twelve miles in a south-east direction from the extreme point the party reached. We therefore reluctantly returned to the low country without fully attaining our object, having been absent eight days. Three distinct tribes inhabit the Anamalai hills ; they are denominated Kâders, Paliars, and Malsars. The Kâders perform no menial labour; as their name implies, they are the lords of the hills; they will carry a gun, and loads also as a favour, and are expert at stalking game, but are deeply offended if they are called coolies. They are a truthful, trustworthy, and obliging tribe, and exercise some influence over the Paliars and Malsars. Small in stature, their features resemble the African ; they have curly hair tied in a knot behind, and file the four front teeth of the upper jaw to a point, as a marriage ceremony. The upper ranges are in undisturbed possession of wild beasts ; we saw a large herd of bison, with samber and ibex in numbers, and also traces of wild elephants.

The soil on the summit of these fine mountains is deep, and covered with good pasture. Streams of water are numerous, and flow throughout the year. From the extent of forest, the resemblance of the Flora to that of Ceylon and the corresponding altitude, these hills seem suitable for the cultivation of coffee on a large scale, and for colonisation of small communities of Englishmen.

3. On the Contractions suffered by Sulphuric Acid on being mixed with Water. By Dr Lyon Playfair, C.B.

4. On the Constitution of Anthracene or Paranaphthaline, and some of its Products of Decomposition. By Professor Anderson.

The following Gentleman was elected a Fellow of the Society:—

Alex. E. Mackay, M.D., R.N.

The following Donations to the Library were announced :—

Quarterly Report of the Meteorological Society of Scotland for the Quarter ending 30th December 1860.—*From the Society.*

The Canadian Journal—March 1861.—*From the Canadian Institute.*

Report of the Yorkshire Philosophical Society—1860.—*From the Society.*

Transactions of the Royal Irish Academy. Vol. XXIV., Part 1. 1860.—*From the Society.*

Bulletin de la Société de Geographie. 4me Serie. Vol. XX. 1860.—*From the Society.*

Silliman's American Journal of Science and Arts. March 1861.—*From the Editors.*

Atti dell Imp. Reg. Istituto Veneto. Vols. V. Parts 6–10; VI. Parts 1–3.—*From the Institute.*

Sitzungsberichte der Kaiserlichen Akademie der Wissenschaften. Wien, 1860. 8vo. Math.-Natur. Classe, B. XLI., Nos. 13–21; XLII., 22–26. Phil.-Hist. Classe, B. XXXIV., No. 2; XXXV., Nos. 1, 2.—*From the Academy.*

Archiv f. Kunde Osterreichischer Geschichts-Quellen. B. XXIV., Part 2.

Mémoires de l'Académie des Sciences. Tome XXVIII. Paris, 1860. 4to.—*From the Institute.*

Abhandlungen der K. Bayerischen Akademie der Wissenschaften. Math.-Phys. Classe, B. VIII., Part 3. Philos.-Philol. Classe, B. IX., Part 1. Historischen Classe, B. VIII., Part 3.—*From the Bavarian Academy.*

Gelehrte Anzeigen, B. XLIX. and L.—*From the same.*

Glossarium op Maerlants Rymbybel, door J. David. Brussel, 1861. 8vo.—*From the Royal Academy of Belgium.*

Alexander's Geesten, van J. van Maerlant. Brussel, 1860. 8vo. —*From the same.*

Memoires Couronnés de l'Académie Royale des Belgique. Tome X., 1860. 8vo.—*From the same.*

Bulletin de l'Académie Royale de Belgique. 2me Sér. T. IX. and X. 1860. 8vo.—*From the same.*

Annuaire de l'Observatoire Royale de Bruxelles. Par A. Quetelet. 1861.—*From the same.*

Annuaire de l'Académie Royale de Belgique, 1861.—*From the same.*

Mémoires de l'Académie Royale de Belgique. T. XXXII. 1861. 4to.—*From the same.*

Phénomènes Periodiques. Par A. Quetelet. 8vo.—*From the Author.*

Sur la Physique du Globe. Par A. Quetelet. 8vo.—*From the same.*

Observations des Phénomènes Périodiques. Par M. A. Quetelet. 4to.—*From the same.*

Sur le Congriès international de Statistique. Par Ad. Quetelet.—*From the Author.*

Proceedings of the Academy of Natural Sciences of Philadelphia, pp. 285-579.—*From the Academy.*

Journal of the Academy of Natural Sciences of Philadelphia. New Series. Vol. IV., Part 4. 1860.—*From the same.*

Observations on the Genus Unio. By Isaac Lea, LL.D. Vol. III., Part 1.—*From the Author.*

Smithsonian Contributions to Knowledge. Vol. XI. 1859.—*From the Smithsonian Institution.*

Proceedings of American Association for Advancement of Science. 1859.—*From the Association.*

Ohio Agricultural Report, 1858. 8vo.—*From the Ohio Board of Agriculture.*

Memoirs of American Academy of Arts and Sciences. New Series. Vol. VII. 1860.—*From the Academy.*

Transactions of American Philosophical Society. Vol. XI., Part 3. Philadelphia, 1860.—*From the Society.*

Proceedings of American Philosophical Society. Vol. VII., No. 63. 8vo.—*From the same.*

Monday, 4th March 1861.

Monday, 18th March 1861.

Monday, 1st April 1860.

Monday, 15th April 1861.

Monday, 29th April 1861.

PROCEEDINGS

OF THE

ROYAL SOCIETY OF EDINBURGH.

SESSION 1861–62.

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Monday, 2d December 1861.

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